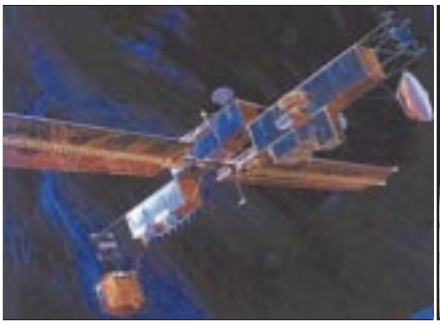
Composite Materials Reduce Weight of Waste Heat Radiators for Several Satellite Systems



Payoff

Strong, lightweight, efficient graphite/cyanate ester composite is replacing aluminum for spacecraft waste-heat radiators. Besides the weight savings of the material choice, the improved structural and thermal performance of the composite hardware may preclude the necessity for extra equipment on the spacecraft such as thermal doublers or auxiliary radiators. More lightweight and compact launch packages can thereby be planned and executed.

Accomplishment

Scientists at the Air Force Research Laboratory's (AFRL's) Materials and Manufacturing Directorate (ML) contracted with scientists and engineers at Lockheed Martin to develop and transition a high performance composite material to several satellite systems. Composite waste-heat radiator panels allow weight savings of as much as 50 percent over conventional aluminum panels, a contributing factor for reduction of spacecraft launch costs.

Background

Spacecraft for the Air Force, Navy, other government services and commercial users are built with structural radiators to conduct waste heat away from thermally-sensitive electronic and power components. Traditionally, these radiators have been made of aluminum. The Materials and Manufacturing Directorate contracted with researchers and engineers at Lockheed Martin Astronautics of Denver, CO, and Lockheed Martin Missiles and Space of Sunnyvale, CA, to develop new composite materials having thermal and structural performance superior to aluminum and capable of saving room while reducing weight on these spacecraft. This material is constructed of a high-modulus graphite fiber that offers excellent stiffness and outstanding thermal conductivity, matched with a cyanate ester matrix having a good uniformity and reliability performance record for spacecraft components. The development effort successfully achieved program objectives by producing a prototype composite radiator panel that exceeded all property requirements. This panel's innovative design offers simplicity, low cost and high stiffness, as well as high in-plane thermal conductivity, and a weight approximately 33 to 50 percent less than comparable aluminum panels. Because the Lockheed Martin groups responsible for development of the composite panel are also in the spacecraft manufacturing business, they have transitioned panels using the new technology to several military and commercial satellites. One spacecraft, the STRV 1-D, is an experimental joint-effort between the U.S Air Force Ballistic Missile Development Office (BMDO) and its British counterpart organization. In this application, a piece of sensitive equipment needed to be thermally isolated from other equipment on the same panel, so Lockheed Martin engineers developed an insert made of graphite fiber in cyanate ester matrix that successfully provided the required thermal isolation behind the instrument in question. Lockheed Martin also designed composite structural radiator panels for the Air Force Milstar communications system satellites to reduce weight by 50 percent, while improving thermal performance in directing heat away from sensitive components – all while maintaining structural performance requirements. Radiator panels constructed of graphite fiber in cyanate ester matrix are in use in several satellites of the Mars Global Surveyor program, including a battery panel on board the Mars '98 Orbiter.